CLAIMS

We Claim:

1. A method for verifying combustion in a burner of a fuel reformer during warm up and steady operation, the method comprising the steps of:

detecting for flame within a burner of a fuel reformer during an initial warm-up stage of operation of a fuel reformer;

proceeding with operation of the fuel reformer if a flame is detected within the burner;

monitoring a temperature of a catalyst within the burner to determine the occurrence of flameless catalytic combustion;

proceeding with operation of the fuel reformer if a predetermined temperature is achieved by the catalyst within the burner; and

producing a burner exhaust.

2. The method of Claim 1, wherein the step of detecting for flame is accomplished by at least one flame detector.

3. The method of Claim 2, wherein the at least one flame detector is selected from the group consisting of a flame ionization detector, an ionization/rectification flame detector, a light-based flame detector, an ultraviolet light detector, a photoelectric eye, a visible light detector, an infrared detector, or a combination thereof.

4. The method of Claim 1, wherein the step of monitoring a temperature is accomplished by at least one temperature sensor.

5. The method of Claim 4, wherein the at least one temperature sensor is selected from the group consisting of thermocouples, thermistors, resistive temperature devices, thermometers, infrared detectors, and a combination thereof.

6. The method of Claim 1, further comprising the step of determining the completeness of combustion after the step of producing a burner exhaust.

7. The method of Claim 6, wherein the step of determining the completeness of combustion comprises the step of sensing for oxygen in the burner exhaust to produce a reading, wherein a positive reading for oxygen indicates complete combustion.

8. The method of Claim 6, wherein the step of determining the completeness of combustion comprises the step of sensing for hydrocarbon fuel in the burner exhaust to produce a reading, wherein a negative reading for hydrocarbon fuel indicates complete combustion.

9. The method of Claim 7, wherein the step of sensing for oxygen is accomplished by an oxygen sensor.

10. The method of Claim 9, wherein the oxygen sensor comprises an automotive-type oxygen sensor.

11. The method of Claim 8, wherein the step of sensing for hydrocarbon fuel is accomplished by a hydrocarbon sensor.

12. The method of Claim 1, wherein the predetermined temperature of the catalyst within the burner is above the temperature at which the catalyst operates as a flameless oxidation catalyst.

13. The method of Claim 12, wherein the step of monitoring a temperature comprises the steps of:

providing at least two temperature sensors within the burner;

comparing an output of each temperature sensor; and

registering a "system error" if the difference between any two outputs exceeds a predetermined value.

14. The method of Claim 6, further comprising the step of controlling a burner input based on the completeness of combustion.

15. The method of Claim 7, further comprising the step of controlling a burner input based on the reading for oxygen in the burner exhaust.

16. The method of Claim 8, further comprising the step of controlling a burner input based on the reading for hydrocarbon fuel in the burner exhaust.

17. A burner assembly associated with a fuel reformer designed to combust fuel in a manner in which lean combustion of the fuel can be verified, the burner assembly comprising:

an outer shell housing a combustion chamber comprising a burner;

a catalyst bed situated within the combustion chamber;

a mixing zone in fluid communication with the combustion chamber;

an air inlet and a fuel inlet in communication with the mixing zone, wherein a supply of air through the air inlet and a supply of fuel through the fuel inlet are mixed within the mixing zone;

an exhaust outlet in fluid communication with the combustion chamber, wherein an exhaust stream is discharged from the combustion chamber through the exhaust outlet;

a flame detector positioned such that it is capable of detecting the existence of flame in the combustion chamber;

a temperature sensor positioned such that it is capable of monitoring temperature of the catalyst bed; and

an exhaust detector positioned downstream of the catalyst bed and capable of detecting at least one of either oxygen or hydrocarbon in the exhaust stream.

18. The burner assembly of Claim 17, further comprising a controller for controlling at least one of either the supply of fuel and the supply of air admitted to the mixing zone.

19. The burner assembly of Claim 17, wherein the flame detector is selected from the group consisting of a flame ionization detector, an ionization/rectification flame detector, a light-based flame detector, an ultraviolet light detector, a photoelectric eye, a visible light detector, an infrared detector, or a combination thereof.

20. The burner assembly of Claim 17, wherein the temperature sensor is selected from the group consisting of thermocouples, thermistors, resistive temperature devices, thermometers, infrared detectors, and a combination thereof.

21. The burner assembly of Claim 17, wherein the exhaust sensor comprises a hydrocarbon sensor for sensing hydrocarbons in the exhaust stream to produce a reading, wherein a negative reading for hydrocarbon indicates complete combustion.

22. The burner assembly of Claim 17, wherein the exhaust sensor comprises an oxygen sensor for sensing oxygen in the exhaust stream to produce a reading, wherein a positive reading for oxygen indicates complete combustion.

23. The burner assembly of Claim 22, wherein the oxygen sensor comprises an automotive-type oxygen sensor.